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AUTHOR Layton, James R.: And Others
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ABSTRACT

This paper proposes a Piagetian model for an early childhood science education program which provides opportunities for children to learn logical thinking and to prepare them for reading and writing. Discussed are suggestions for science areas of concentration, abilities to consider, substructure levels, cognitive thinking skills, and schemes. A sample unit on water, including a discussion of these areas, is provided. A step-by-step transition from this unit to reading and writing is detailed. It is concluded that, although science can stimulate reading and writing skills, it should not be taught as a reading-based, verbal-symbols information gathering system. (CS)

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Transition of Science Concepts: Preschool to Beginning Reading and Forward

James R. Layton, Darrell L. Roubinek, and Dale G. Range
School of Education and Psychology
Southwest Missouri State University
Springfield, Missouri 65802

A
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A recent edition of the NAEP Newsletter (1979) contained information indicating that science has caused some or almost all of the contemporary problems facing Americans. The report also contained data to support the idea that interest in science as an area of study or career choice is diminishing among 13- and 17-year-old students.

In the NAEP document, 9-year-olds were reported as having favorable attitudes toward science. If the drop in interest by age 13 and 17 is a trend, what is causing it? The source of the problem, according to one noted authority quoted in the publication, was elementary teachers' inabilities to teach science effectively.

However, projections as to the source of the problem could be extended to include the idea that when elementary students reach junior and senior high school levels, they have not been prepared to identify problems, plan appropriate procedures for solving them, nor taught the necessary cognitive, intellectual performance, or linguist skills necessary to think and act scientifically. Science performance must be viewed as more dynamic and far-reaching than knowledge of subject matter per se.

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This paper contains ideas and procedures to use the early childhood science education curriculum as a medium to teach children to develop specific substructure, motor, perceptual, cognitive/intellectual, and linguistic skills that will lead to learning to read (Radin and Weikert, 1967). It reverses an idea held by many persons that learning to read should precede the study of science and scientific methods.

It is our contention that if science educators in the secondary schools wish to reverse the trend noted in 13- and 17-year-old students, they should study the nature of elementary and early childhood science curricula and become involved in it. Just studying the curricula will not suffice to solve the problem. Only when early childhood and elementary science, mathematics, and reading coordinators develop a cooperative spirit, will science be treated with proper respect and given the status it deserves in the elementary school curriculum.

The cognitive curriculum developed by Weikert (1971) was developed from the developmental theory contained in the works of Piaget. The curriculum was designed to allow teachers to provide children in preschool through third grade classes with opportunities for learning cognitive or thinking skills. According to Weikert, those cognitive or thinking skills are necessary for children to develop perceptual functions and subsequently concepts that are used to organize information and interpret relationships among figural, symbolic, and semantic information in their environment.

It is the purpose of the writers of this paper to reveal how the goals and objectives developed for the general program, based on sound learning principles, may be employed by early childhood science coordinators and teachers of young children to develop science programs using the same principles. Once established, the early childhood science curriculum can result in a dynamic educational environment through which teachers can provide for children's development of biological, chemical, and physical scientific knowledge. But, the learning will not stop there; the results of such a program are much more far-reaching. Ultimately, the science curriculum can be used to guide and direct children to arithmetic, reading, and writing skills if appropriate procedures are followed.

Children need opportunities to learn logical thinking skills by being involved in activities in which they will learn the following:

1. information about themselves and figural contents (objects) through a variety of experiences;

2. relationships that exist between themselves and objects in space or learning spatial relationships; and

3. sequencing and classifying or categorizing figural contents or symbolic information or happenings according to relevant attributes or time of occurrence (physical and abstract).

By progressing from real (figural contents) objects to symbolic content (pictures, toys, and signs) teachers can be assured that children will have more appropriate opportunities to achieve the ability to mentally manipulate semantic verbal symbols in a logical and appropriate fashion to deal effectively with their world.

Another result of such a program will be children's development of overt language production skills that will reflect their overt cognitive abilities. Those language (speaking and listening) skills will be the substructures for the children's successes in developing prereading and premathematics skills (readiness) and the same language skills that will be used by teachers to determine intelligence and predict future school success.

Four essential schemes for skill development in early childhood science programs are contained in the model science program presented in this paper. Those schemes are as follows:

1. Classification Schemes. Children learn to recognize or identify relevant features of three dimensional objects or sounds made by those objects as to their similarities and dissimilarities. Consequently, children will learn to attend, commit information to memory, develop nonverbal areas of the brain, discriminate between sounds and objects, and match sounds with objects.

2. Seriation Schemes. Children learn to use relevant configurational data, personal preferences, familial or

societal values, (plus other information or, numerical counting) to order figural content (real objects) by size, quality, or quantity.

3. Objects' Positions in Space Schemes. Children learn to perceive all figural content (real objects) and sounds in relationship to themselves. In reality, their midline (or waist) is viewed as the center of their environment and all objects and sounds are above, below, beside (to the left of or the right of), in front of, or behind them. They also learn of Spatial Relations in which they view their position in the environment (as well as another objects' position) to themselves and to that of another object. As a result, they extend their knowledge that not only can they go in, over, or through something, but that another object may go between, through, around, or among them and the other object or objects. Also, children learn that similar happenings can occur between or among objects or sounds they witness. The implications of such learning are probably more relative to the area of science than any other subject matter area.

4. Relations of Temporal Data Schemes. Children learn the basic principles of time sequences and chronological order. They learn concepts of beginning and ending; when happenings occurred; endurance or length of an event; time of departure, arrival, and return; sequence of events or happenings; in-

tervening events during an activity; and many other time-related concepts.

Early childhood science curriculum developers or teachers of young children must design programs that contain aspects of all of the four schemes presented above. Learning resulting from those areas will develop children's verbal and nonverbal abilities that have been demonstrated by many researchers as the substructures of later success in mathematics, reading, handwriting, and composition skills. However, the early childhood science curriculum designed would not be complete if the designers did not also provide for the following components of a cognitive-based curriculum.

1. Index Component. Children use visual imagery abilities to mentally picture an object, sound, movement, or sensation. Based on the mental picture, they complete a missing portion of an incomplete puzzle or representation. At this level, teachers can gain much information as to the children's problem solving abilities and processes, memory skills, and facility for using oral language.

2. Symbolic Component. As children develop and sophisticate their abilities to use imagery, the images become clearer. As children enter into free play, construct models of clay and other materials, expressive and receptive language continues to develop. At this level too, teachers can gain much information related to children's linguistic/intellectual competences and performances.

3. Sign Component. Children enter into a variety of physiological and language experiences in which they use simple scientific equipment and materials to verbalize their experiences.

4. Tactile/Kinesthetic Component. Children use all sensory modalities in addition to vision and hearing (plus large motor activities) to develop skills to move within their environment, explore, and discover by observing, collecting, and storing information. Those receptive abilities and movements will be used also to produce and/or transmit information in the form of models, pictures, nonverbal gestures, and subsequently, writing.

5. Verbalization Component. Children use language abilities to express their thoughts and ideas and also their knowledge and interpretations of information they have received.

The four schemes and five components should not be viewed as separate and distinct except when provisions are being made for their inclusion into the activities for children. However, the schemes and components do contain information that may be used by coordinators and teachers in early childhood science programs as guides in providing for children's needs at appropriate times.

Children who have not reached a stage of being able to recall the attributes of a figural objects, sounds, movements, or sensations (index level) and transfer that information to an incomplete representa-

tion, will probably not be able to reproduce those same elements at the symbolic or sign level. However, children may enter activities at the symbolic level (free play, constructing models, and so forth) and the sign level (using scientific equipment and materials) even though their products may be incomplete. Children who demonstrate those characteristics should be provided with a wealth of activities at the index level.

Children will always be at the verbalization level. However, teachers must distinguish between the children's thinking competence and language production. Children may be fully competent to perform classification, ordering, and spatial skills, but lack the language skills to express their skills. But, the children may develop intellectual and language skills which they can utilize to discriminate, but lack the appropriate experiences at the index level. Those children may find it difficult to perform adequately (i.e. it would be difficult to order chickens, goats, cows, and horses according to size if they had not been viewed figurally or accurately symbolized in models or pictures).

The tactile/kinesthetic component should be present in almost all early childhood science activities. Skills that are to be attained at the index level would be impossible to develop without tactile/kinesthetic (touching and movement) experiences. The kinesthetic experiences are especially important (in combination with the symbolic level) for they provide a basis for the development of fine motor abilities as well as visual and auditory efficiency that are necessary for children to be able to learn to perform arithmetic skills, read,

and write. The verbalization level, and language competence and production learned through experiences in the other areas will provide children with semantic knowledge and syntactical patterning abilities that will be substructures to mathematics, reading, spelling, and composition skills at a later period in their lives.

The concrete nature and extensiveness of content found within the broad area of science (physical, biological, and chemical) make it the most perfect curriculum for developing early childhood education programs. Through the medium of science, teachers will be able to stimulate and expand children's growth in language and intellectual behaviors. Additionally, the teachers can provide an environment for social behaviors as well. Those social behaviors will form the children's foundations or substructures for later learning in the social sciences. And too, the early childhood science curriculum would include provisions for art and musical activities which will be precursors to the children's future studies in general science, biology, mathematics, and physics. The future possibilities of such a program are tumultous.

The Specific Design

The early childhood science curriculum would be designed to include all of the areas or topics contained in the elementary and secondary curriculum. Those areas are usually the following:

(Schneider and Schneider, 1965):

1. weather	5. electricity	9. geology
2. earth and space	6. human body	10. conservation
3. matter	7. animals	11. minerals
4. energy	8. plants	12. soil

A complete early childhood education program cannot be presented in this paper. However, it is possible to outline a sequence of the steps and stages that would be followed in one activity that would be used to guide children from a nonreading level to a reading level.

The approach would be to use children's dictated stories and writings as the reading material; the reading method would be analytical. However, even though the analytical reading method (beginning with whole words) will be used to teach reading initially, the children will be taught auditory discrimination skills that will be substructures of the skills needed in the basal reading and spelling program used in kindergarten and/or first grade, or in subsequent elementary grades. If properly designed, the early childhood science curriculum and reading program as explained in this paper, could serve as the total reading program.

It must be noted that the list of abilities are not given in a time sequence. Neither is it attempted to specify the ages at which children would begin to develop the abilities. In reality, they could begin prior to the three-year-old level, or beyond three years of age. There are no guidelines for introducing the aspect of reading to the

children. That must be determined by the teacher who monitors and evaluates the children's performance in the following areas. (Layton, 1979; Range, Layton, and Roubinek, 1980).

1. Oral language production (speech).
    a. vocabulary
    b. syntactical patterns
    c. memory
    d. attention
    e. oral context (requires auding)
2. Listening efficiency
    a. auditory acuity
    b. auditory discrimination
    c. auditory memory for details and Gestalt
    d. auditory sequential memory
    e. auditory closure
    f. auding
3. Visual efficiency
    a. visual acuity
    b. visual discrimination
    c. visual memory for details and Gestalt
    d. visual sequential memory
    e. visual closure

f. visual comprehension

g. strabismic efficiency and binocular shifting ability

4. Matching of Visual and Auditory Stimuli

5. Physical efficiency

a. knowledge of body parts and uses

b. large muscle development

c. fine muscle development (as appropriate)

d. hand-eye and eye-hand coordination

e. development of body asemetry

f. development of dominance

g. development of strength

h. development of rhythm and agility

6. Cognitive and intellectual efficiency

a. intellectual curiosity

b. memory for nonverbal information

c. memory for verbal information

d. matching nonverbal and verbal information and memory thereof

e. development of short term and long term memory

f. problem solving through divergent (exploration) and convergent thinking skills

g. judgment ability (interrelated with divergent and convergent thinking)

h. appreciation ability

i. curiosity

The early childhood science curriculum must be written to contain guidelines for the teacher to use to insure that children develop abilities in the areas specified. Each has been identified by researchers as related in some way to a child's success in beginning reading and mathematics. To further assure themselves that they are involving the children in cognitive, intellectual, and language growth, teachers must ascertain that children are given questions to answer or problems to solve in which scientific content (figural (real)), symbolic (models, toys, pictures), and semantic (signs and symbols with literal or abstract meanings) are presented visually, auditorily, and nonverbally (physical gestures). The following list can guide to the development of those activities.

1. Learning to identify, classify, grade, or rank the attributes of a single object of sound (size, shape, pitch, use, and so forth) and/or classify objects or sounds to be fitted into a broader category or genus (liquid, solid, loud, soft, and so forth).

2. Learning the sequential order, or succession of which events, sounds, actions, or other processes that occur (the procedure for making steam, the growth of a plant from seed to fruit, and so forth).

3. Learning that objects, symbols, and sounds may be reorganized, transformed, metamorphized, or transfigured through natural or contrived action (burning fuel and studying residue from fuel, smoke, and so forth; observing moths, growth

of seed, simple chemical reactions, weathering effects, and so forth).

4. Learning to make predictions and draw conclusions (or infer implications) through studying classifications, sequences, transformations, systems, and so forth from the data gathered and/or observed (forming or testing hypotheses).

A Comprehensive View

To develop the early childhood science education program, the following chart may be helpful. It contains the major areas that must be included systematically and consistently in the activities that are developed for the children.

AREAS OF CONCENTRATION	ABILITIES TO CONSIDER	SUBSTRUCTURE LEVELS	COGNITIVE, INTELLECTUAL THINKING SKILLS	SCHEMES
weather	oral language	index	classify	classification
earth	listening efficiency	symbolic	order	seriation
space	visual efficiency	sign	sequence	position in space
matter	physical efficiency	tactile	reorganize	spatial relations
energy	cognition	kinesthetic	transform	temporal relations
electricity	intellect	verbalization	transfigure	
human body			metamorphisis	
animals			prediction	
plants			conclusions	
geology			inferring	
conservation			implications	
minerals				
soil				

Any area of concentration in science may be used to develop the lessons or activities. However, children should be introduced to and allowed to explore their immediate environment first and learn about relevant matters. Gradually they would explore beyond the immediate environment. For the purpose of this paper, a sample unit on water will be outlined.

A Sample Unit: Water

Assumptions

1. Children will know some things about water. They will have experienced it, and will bring many ideas to the learning experience.

2. Children can learn new information about water and those new learnings plus old learnings may be used by teachers to stimulate children's continued upward growth in sub-structure levels, schemes, and intellectual, cognitive, and thinking skills.

Assurances

Teachers must be assured that students have experienced the source of water. Depending on the locale, students should be provided enough of the following figural experiences to establish their background of knowledge.

1. Visit a well or spring that is working.

2. Visit a lake, stream, river, and so forth.
3. Visit a sewage treatment plant and/or an industrial waste treatment plant.
4. Observe a rain and watch the water drain or observe water draining as snow melts.

Many questions may be asked by the teacher, during the direct experiences but the important aspect of this experience is the teacher's skill to develop awareness and recognition so that index level skills can be developed, scheme activities can be planned, as well as cognitive, intellectual, thinking skill activities.

Activities

Once the teacher is satisfied that the children have sufficiently encountered water (figural experiences), then activities may be designed for the children to develop the skills referred to earlier in this presentation. In the classroom, the teacher would design lessons at the symbolic level (using pictures and toys) as well as the figural level (use of water and containers) to extend the children's learning.

Classifying or Classification

Using pictures, films, filmstrips, the children's memories, audio recordings, and other figural or symbolic stimuli, children could classify water in the following ways:

1. Clean Water
2. Dirty Water
3. Running (moving) Water
4. Uses of Water (Home, Business, Industry)
5. Containers to Hold Water
6. Sources of Water
7. Damage by Water
8. Fun in Water
9. Danger in Water
10. Conservation of Water

Order of Seriation (by size, quality, quantity)

Using the same materials as specified for classifying, children could become involved in the following activities:

1. Sizes of bodies of water in (immediate environment)
2. Quality (purity) of water from various sources
3. Number or quantity of bodies of water (in immediate environment)
4. Priority list of why water should be conserved
5. Sounds of water (soft to loud) (also quality, etc.)

Position in Space

Students would discuss their observations, pictures, filmstrips and so forth to describe water in the following ways:

1. Direction of water movement (over, on, away, down, up, etc.)
2. Size (as relates to child's size)
3. Position of water from child's position (under, over, beside, in front of, etc.)

Spatial Relations

In addition to position in space, children would also describe water in terms of its containment or movement and in relationship to the child's position and that of another object.

1. Water moving out of a container or other object
2. Water moving into a container or other object
3. Water moving over an object
4. An object moving on, over, or in water

(Note: The possibilities of developing questions at this point are endless. As objects moving in or on water are encountered, then ordering and classification tasks can be developed (i.e. things that move in water, that do not move in water, speed (slow to fast) of objects in water and so forth).

Temporal Relations

Children would use memory skills and pictures and so forth to answer questions having to do with time sequences in which events occurred.

1. Placing models or pictures (real or facsimiles) in order of visit
2. Specifying visits made in morning or afternoon
3. Discussing what was seen first, second, third, etc.
4. Discussing or using pictures or models to specify such things as sequence followed to get water from source to the home. How water gets to the reservoir. Water from use (in the home) to disposal, etc.

Only a few of the possibilities for activities are presented above. But teachers' attention to each of the schemes posited will insure that the children's nonverbal, language, intellectual development will be assured as well as their cognitive and intellectual behaviors. Additionally, teachers should provide additional experiences and integrated experiences among the schemes and substructure levels as presented below.

Index Component

Using a memory and visualization skills, children will complete incomplete representations in symbolic visual or auditory stimuli.

1. Producing, thus adding the sound to a picture of a stream, a dripping faucet, rain on a roof and so forth. (The sound may be by mouth, fingers, or other devices).

(That type activity is the substructure for auditory discrimination).

1. Adding a picture to a series of pictures of one of the visitations that is missing

(That type of skills involves sequencing and ordering).

2. From a picture puzzle of a lake, river, or processing plant, children determine how to reconstruct the picture.

Symbolic Component

Activities for this level will include verbal interaction with the teacher, other students, and possibly resource persons about water.

Other activities would include the following suggestions:

1. Drawing pictures of various aspects of the experience with water
2. Making clay models of dams, lakes, etc., and filling them with water

Sign Component

Activities for this level would include physical experiences of working with equipment and materials. The teacher must insure that all activities are safe for the children. Some may have to be demonstrated, but manipulation by the children would be better. Children must also verbalize their experiences.

1. Weighing (balance scales) water with an equal amount of sand, dirt and so forth (also develops seriation skills)
2. Boiling water to produce vapor then observing, through using glass condensing coils; how the vapor (and steam returns to liquid state (this also develops transformation knowledge)
3. Testing water with simple test devices to determine quality (Seriation); then using boiling, chemicals (iodine), or other processes to purify the water;

   A retest of the water would follow.

(This activity would also involve transformation as well as predicting outcomes, drawing conclusions, making inferences and so forth, if appropriate questions were asked. Implications could also be drawn from the results).

1. Discussing experiences and answering questions to develop auding skills as well as auditory discrimination skills.

Teachers would ask questions that would require children to answer questions using all of the cognitive, intellectual, and thinking skills (divergent and convergent) listed in the chart. At this level, teachers would introduce auditory discrimination skills and substructure skills to formal phonics skills. Examples would be as follows:

How many things will hold water that begin with the same sound that you hear at the beginning of bottle? (Repeat for other sounds; ask similar questions about other things).

bottle?	water?
bucket	well
bowl	wash tub
balloon	washing machine
basin	
basement	

The next step beyond asking will require that a variety of toy or small objects be purchased that represent real objects and begin with the 44 phonemes in English. At that point, children will classify the figural/symbolic items by placing them in appropriate boxes. The letter (lower case) and a picture of one of the items would be on the outside of each box. Once children could classify items by initial sounds (by placing them in the correct box), then the teacher may place

one or several incorrect items in a box with correct items and allow the children to determine the discrepancy. Later, exercises could include the use of pictures, and finally written words.

At the appropriate time, words would be written on the boxes, on the pictures of single objects, and in sentences. Those steps will be presented later.

Kinesthetic/Tactile Component

Kinesthetic and tactile experiences should be included in all experiences. Large muscle, motoric exercises that lead to eye muscle efficiency. Small motor efficiency in the hands and finger is essential. Also, gustatory and olfactory (tasting and smelling) experiences at this level will add much to the children's development of motor, perceptual, conceptual skills that will be necessary for reading to occur naturally and easily.

Verbal Component

Children will utilize the verbal level throughout their experiences. Teachers must ask questions that will allow the children to use all of the cognitive, intellectual, thinking skills listed on the chart. It is important, too, that teachers insure that children can name a wide variety of sounds and objects, and remember them. Beyond that, questions must be asked requiring children to use evaluation of their ideas as they use divergent and convergent thinking to solve problems.

Some examples of those questions would be as follows:

1_1. How many ways do we use water? (divergent; listing of details)

1_2. What is the best use made of water? (convergent; seriation)

2_1. How many ways can water be changed, but quickly returned back to water? (divergent; details; transformation)

2_2. What one way can we change water into a form in which it cannot be seen? (convergent; transformation)

3_1. What would happen if tomorrow we awakened and there was no water safe to drink? (convergent; implications; prediction; conclusions, etc.)

3_2. Can that be prevented? How?

The questions related to science learning could be endless. And, as children learn about science through concrete materials and physical actions along with language involvement, they also learn prosocial behaviors. Questions such as 3_2 above are examples of those learnings.

All that has been presented thus far in this paper is an outline of the many aspects of children's psychophysiological development that must be stimulated if they are to be able to learn to read. It is believed that the early childhood science education curriculum is the most perfect area of the curriculum to use in planning for that development.

This paper was not written as an argument against the use of basal readers as the materials which should be used to teach formal beginning reading. But it is contended that too many times, children's intellectual and language skills are disregarded and too much emphasis is placed on their abilities to learn verbal symbols, write in workbooks, and learn from workbooks and other printed materials. In many instances, those tasks are introduced prior to the children's establishment of specific cognitive skills, wide backgrounds of information, and visual auditory discrimination skills.

The Transition to Reading, Step by Step

Specific procedures, that would include the aforementioned ideas, to lead the children to reading and writing, are as follows:

Step 1. A lively discussion of water (includes some or all of those ideas presented earlier).

Step 2. Providing the children with magazines from which they cut pictures of various pictures of water in different forms. The pictures are pasted on a page. The teacher writes one word, on the page for each child. Later the children may dictate a sentence (main idea) about a picture which the teacher will write. At the appropriate time, the children will be allowed to write their own sentences. Child could also draw the pictures.

The pictures could be used for bulletin board displays, collected by the child and placed in science notebook under W for water, or used in many of the discussion sessions recommended earlier in this paper.

Step 3. When children are able to see the chalkboard and have developed a concept of words and reading (which is vital!), then the teacher may begin a stimulating discussion and at the ideal moment, ask, "Who can tell me what we did today? I want to write it on the board."

". . . made frost." A child may answer.

To insure that correct syntactical patterns are being developed, the teacher should respond, "Yes, John, that's good! Could you say it again and begin with the word today?" (If teachers say, "Make a complete sentence," the children may not have developed that concept).

John replies, "Today we made frost."

"Great!" Replies the teacher. "Everyone watch as I write what John said on the chalkboard."

Today we made frost.

"Who can tell me what we did first?" Questions the teacher.

This procedure continues until a short simple story similar to the one below is written:

Today we made frost.
First we got a can.
Next we put ice in it.
Then we put salt in the ice.
Soon, frost was on the outside of the can.

It is important that questions, discussion, and interaction occur prior to and during the writing. It is essential that children see the words being written. The stories must begin with a main idea. The teachers should guide children to produce sentences that support the main idea. The sentences may be details, ordered (as in the example), characteristics or descriptions, comparisons or contrasts. As much as possible words should be repeated (we, put, and in, in the example) large words should not be eliminated. A child can learn electricity and generator easier than discriminating between those and these in the early stages of development.

In the initial stages, children should not be required to learn any of the words. They should observe first. As the teacher determines that the children can be successful, they may read the short selections in unison. Following that, individual children who volunteer should be allowed to read the selection. Those children may also lead the choral (unison) reading.

As children become adept at reading the selections, the teacher may copy the stories on cardboard and cut them into sentences (first) and words (after sentences are mastered) then allow the children to reconstruct them on a board with slots to hold the sentence and word strips.

Step 4. When children are able to write, their first experiences should be in labeling pictures, then copying sentences, and later, copying the language experience stories from the board. Of course, certain prewriting skills should precede formal requirements for handwriting.

When each child has developed sufficient abilities to copy words and remember the letters in other words, they may be allowed to write independently. A good way of doing that is to begin by allowing children to write their own title to the story. Later, the teacher may guide and direct all of the story but the last sentence, then allow the children to create their own endings. That may be prefaced by asking the children to think of how they would end the selection and if they wish for the teacher to write any words they will need on the chalkboard.

At this level children will misspell words, reverse letters and words, and omit the same. Overconcern of the teachers toward these matters which are natural may stifle the children's desires to produce.

Step 5. Children will become able to write their own compositions. They can express what was observed, what they did during an experiment, or write directions for others to follow.

Conclusions

Science can be fun. Science can be exciting. But before reading and writing about science, children's substructure physiopsychological development must be well developed. And too, even though this paper contains suggestions for using science as a medium for teaching beginng reading, the authors have observed that once children have begun the formal study of science in textbooks that science is taught more as a reading subject than the dynamic, living content area that it is. Science should not be taught solely as a reading-based, verbal-symbols information gathering system.

Perhaps if early childhood educators and elementary teachers could place more emphasis on discovery and inquiry techniques and stress cognition, evaluation, as well as divergent and convergent thinking processes, then children would develop more interest in studying science and in using science as a survival tool in their daily lives.

The language experience methods described in this paper were presented briefly. The bibliography contains work that have complete directions for the process (Layton, 1979; Range, Roubinek, and Layton, 1980).

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